November 3rd, 2013
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Inquiry Based Learning Activity

Topic: Column Buckling

Question to students:
Besides the applied load and member material, describe what factors affect the load a column can carry before buckling. Globally, identify the influence of each factor the resistance to buckling, e.g. it makes it about twice as resistant, it makes it significantly stronger, etc.

Answers I am looking for: Cross-sectional geometry and effective length, where effective length is a function of both the unbraced length and the support conditions.

Activity to allow students to investigate the idea:
Students all receive 3 foam "columns". Each column is rectangular with an approximately $^1/_8$" x ¾" cross-section. Lengths are approximately 6", 10" and 14". Students will also be told they can use other items in their possession such as rulers, student ID cards, etc., to investigate the question.

In addition, there will be two model structures in the front of the room (drawn below). The structures will have four "columns" made from thin aluminum or brass strips and "floors" made from plywood. The four columns will be screwed to the plywood along their weak axis. One structure will only have a plywood diaphragm at the base and top of the columns. The other structure will have an additional "floor" at column mid-height. I have some pretty thin brass strips but if those proves too stiff to display the intended behavior, I can build this out of foam strips.
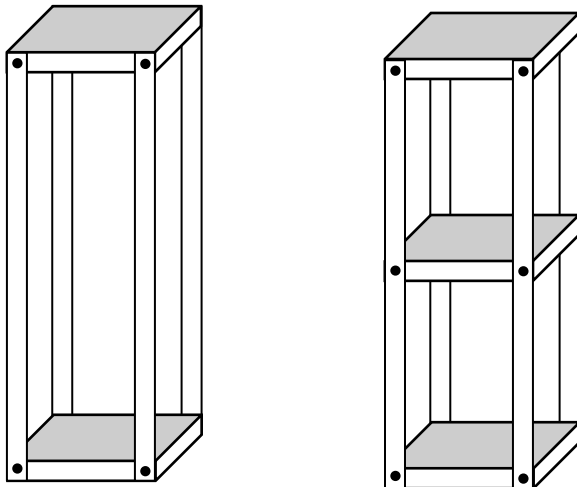
Real world applications:
Bar stools – some have braces at mid height.
Straws – who has buckled one when trying to get the paper off?
Twin Towers ultimate failure mode (buckling of overloaded columns; remaining columns were able to carry extra loading after some columns were destroyed by the plane crash, however subsequent fire resulted in the failure of beams that were reducing effective column lengths, buckling resulted)

Formulas:
Then go over the Euler buckling and have students lead example problems. Be sure problems have different support conditions on weak and strong axis to reinforce concepts of activity.